

## PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-214733

(43)Date of publication of application : 06.08.1999

(51)Int.Cl.

H01L 31/042

(21)Application number : 10-017089

(71)Applicant : KYOCERA CORP

(22)Date of filing : 29.01.1998

(72)Inventor : TAKAHASHI HIROAKI

FUKUI KENJI

SHIRASAWA KATSUHIKO

## (54) SOLAR CELL

## (57)Abstract:

**PROBLEM TO BE SOLVED:** To dissolve the problems of a cell such as the increase in resistance loss, which is generated with an increase in the area of a cell, such as a warpage of the cell, a crack in the cell or separation of electrodes which is generated by the thick formation of a copper foil on a busbar part, which is a countermeasure against the augmentation in the resistance loss.

**SOLUTION:** This solar cell has a substrate, wherein a front electrode 5 consisting of a busbar part and a finger part is formed on the side of the main surface on one side of the main surfaces of a semiconductor substrate 1 having a semiconductor joint, a plurality of solar cell elements formed with a rear electrode 7 are provided on the side of the other main surface of the substrate 1 and the electrode 7 of the plurality of these solar cell elements and the electrode 5 are connected with other through a lead wire 9. In this case, the electrode 5 is provided on the busbar part by bonding a copper foil to the busbar part, and the lead wire 9 is connected with the electrode 5 from the middle part of the electrode 5 in the lengthwise direction of the copper foil.



## LEGAL STATUS

[Date of request for examination]

15.03.2002

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

Copyright (C); 1998,2003 Japan Patent Office

\* NOTICES \*

JPO and NCIPJ are not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.\*\*\*\* shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

---

CLAIMS

---

[Claim(s)]

[Claim 1] The surface electrode which changes from the bus bar section and the finger section to the 1 principal-plane side of the semi-conductor substrate which has semiconductor junction is formed. In the solar-battery equipment which prepared two or more solar battery elements in which the rear-face electrode was formed, and connected two or more of these surface electrodes and rear-face electrodes of a solar battery element to other principal plane side with lead wire Solar-battery equipment characterized by having joined and prepared copper foil in the bus bar section of said surface electrode, and connecting said lead wire to this copper foil from a part middle [ in that die-length direction ].

[Claim 2] Solar-battery equipment according to claim 1 characterized by joining said copper foil to the bus bar section of said surface electrode by two or more places.

[Claim 3] Solar-battery equipment according to claim 1 or 2 characterized by connecting by joining said lead wire to said copper foil by two or more places.

---

[Translation done.]

## \* NOTICES \*

JP0 and NCIP1 are not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.\*\*\*\* shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

## DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the solar-battery equipment to which two or more solar battery elements were especially connected by lead wire about solar-battery equipment.

[0002]

[Description of the Prior Art] Conventional solar-battery equipment is shown in drawing 4 . For 11, as for a surface electrode and 16 (16a), a silicon substrate and 15 (15a) are [ a rear-face electrode and 18 ] lead wire among drawing 4 . The N type field 12 and the P type field 13 are in a silicon substrate 11. A surface electrode 15 (15a) is formed in the front face of the N type field 12, and the rear-face electrode 16 (16a) is formed in the front face of the P type field 13. This surface electrode 15 consists of bus bar section 15a for lead-wire connection, and finger section 15b for current collection. Moreover, the rear-face electrode 16 also consists of bus bar section 16a and the finger section (un-illustrating). In order to make resistance loss small, copper foil is made with the pewter bus bar section 16a of the rear-face electrode 16.

[0003] It consists of copper foil etc. and, on the other hand, an edge is arranged covering the abbreviation overall length on a surface electrode 15, by joining two or more of the places to a surface electrode 15, it connects with a surface electrode 15, an another side edge is soldered to the edge of bus bar section 16a of the rear-face electrode 16 through copper foil 17, and the lead wire 18 for connecting two or more solar battery elements is connected to the rear-face electrode 16.

[0004]

[Problem(s) to be Solved by the Invention] With this conventional solar-battery equipment, there was a problem that a generating current increases, bus bar section 15a of a surface electrode 15 became long, therefore resistance loss increased with increase-izing of the cel area of a solar battery element, and conversion efficiency fell.

[0005] Although what is necessary is just to make the cross section of the lead wire 18 of surface electrode 15 part, or the copper foil 17 of rear-face electrode 16 part increase in order to prevent decline in conversion efficiency, the lead wire 18 of surface electrode 15 part must thicken the thickness, and must make the cross section increase, in order to make it not decrease light-receiving area.

[0006] However, when lead wire 18 became thick and this lead wire 18 was welded [ 15 ] by the hot air or pewter \*\*, this hot air or heat of pewter \*\* could not be easily transmitted even to the pewter of surface electrode 15 part, joining of a surface electrode 15 and lead wire 18 took time amount, and there was a problem that the elongation by the thermal expansion of lead wire 18 became large. Where lead wire 18 is extended, when it was joined to the surface electrode 15 and lead wire 18 was shrunken, compressive stress was impressed to the silicon substrate 11, big curvature occurred in the silicon substrate 11, a cel crack, electrode peeling, etc. were induced, and there was a problem that the manufacture yield fell.

[0007] This invention aims at offering the solar-battery equipment which solved problems, such as curvature of the cel generated by thickening increase of the resistance loss which it was made such conventionally in view of the trouble of equipment, and is generated with increase of \*\* and cel area, and the copper foil of the bus bar section which is the opposite measure, a cel crack, or electrode peeling.

[0008]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, in invention concerning claim 1 The surface electrode which changes from the bus bar section and the finger section to the 1 principal-plane side of the semi-conductor substrate which has semiconductor junction is formed. In the solar-battery equipment which prepared two or more solar battery elements in which the rear-face electrode was formed, and connected two or more of these surface electrodes and rear-face electrodes of a solar battery element to other principal plane side with lead wire Said surface electrode is joined to the bus bar section, copper foil is prepared,

and middle [ in that die-length direction ], said lead wire is connected to this copper foil from a part.

[0009] It is desirable to join said copper foil to the bus bar section of said surface electrode in the above-mentioned invention at two or more places.

[0010] Moreover, it is desirable to connect by joining said lead wire to said copper foil by two or more places.

[0011]

[Embodiment of the Invention] Hereafter, the operation gestalt of invention concerning claim 1 thru/or claim 3 is explained to a detail based on an accompanying drawing. Drawing 1 is the sectional view and flat surface which show 1 operation gestalt of invention concerning claim 1 thru/or claim 3, and, for 1, as for a surface electrode and 7, a semi-conductor substrate and 5 are [ a rear-face electrode and 9 ] lead wire.

[0012] The semi-conductor substrate 1 consists of single crystal silicon, polycrystalline silicon, etc. with a thickness of about 0.3mm. In this semi-conductor substrate 1, there are an N type field 2 and a P type field 3, and semiconductor junction 4 is formed in the interface part of the N type field 2 and the P type field 3. This N type field 2 is formed in the thickness of about 0.3-0.4 micrometers by making the surface section of the whole silicon substrate 1 diffuse the Lynn atom, and removing the diffusion layer of a lateral portion and a bottom surface part after that by arranging the silicon substrate 1 of P type all over a diffusion furnace, and heating in phosphorus oxychloride (POCl<sub>3</sub>). In addition, this semi-conductor substrate 1 may be formed by single crystal gallium arsenide etc.

[0013] The surface electrode 5 is formed in the surface part of the N type field 2. This surface electrode 5 consists of finger section 5b which intersected bus bar section 5a for connecting lead wire 9, and this bus bar section 5a, and was formed by branching. Bus bar section 5a is formed in 2 parallel covering the abbreviation overall length of a substrate 1, finger section 5b intersects bus bar section 5b, and the a large number book is formed covering the abbreviation overall length of a substrate 1. Bus bar section 5a is formed in width of face of about 2mm, and finger section 5b is formed in width of face of about 0.2mm. Such a surface electrode 5 screen-stencils the paste which consists of a glass frit, a binder, a solvent, etc., can be burned at the temperature of about 700-800 degrees C, and is formed by covering the whole with a pewter layer for example, in the end of silver dust.

[0014] Copper foil 6 is stuck on this surface electrode 5 (5a). This copper foil 6 is formed in order to enlarge the cross section of a surface electrode 5 (5a) and to lower the electric resistance of a surface electrode 5, and it is formed in width of face of about 2mm, and the thickness of about 0.16mm. Such copper foil 6 is joined by five points at equal intervals on a surface electrode 5. Thus, if a surface electrode 5 and copper foil 6 are joined only by two or more places, even if the die length of copper foil 6 changes with temperature changes, copper foil 6 will not cut or curvature will not be produced in a substrate 1.

[0015] Although not illustrated, the antireflection film which consists, for example of a silicon nitride film etc. is formed in the front-face side of a substrate 1. Such an antireflection film is formed for example, by a plasma-CVD method etc.

[0016] The rear-face electrode 7 is formed in the rear-face side of a substrate 1. This rear-face electrode 7 also consists of the finger section (un-illustrating) by which intersects bus bar section 7a for connecting lead wire 9, and this bus bar section 7a, and a large number book formation is carried out by branching. Bus bar section 7a is formed in 2 parallel covering the abbreviation overall length of a substrate 1, the finger section intersects bus bar section 7a, and the a large number book is formed covering the abbreviation overall length of a substrate 1. Bus bar section 7a is formed in width of face of about 5mm, and the finger section is formed in width of face of about 0.5mm. Since the rear-face side of a substrate 1 does not need to take reduction of light-receiving area into consideration, it can be formed more broadly than bus bar section 5a of a surface electrode 5, and can reduce the resistance loss by the side of the rear-face electrode 7. Such a rear-face electrode 7 screen-stencils the paste which consists of a glass frit, a binder, a solvent, etc., can be burned, and is formed by covering with a pewter layer for example, in the end of silver dust. In addition, the rear-face electrode 7 may be formed all over the rear-face side of not only when it crosses and prepares bus bar section 7a and finger section 7b, but the substrate 1.

[0017] Copper foil 8 is stuck on this rear-face electrode 7. This copper foil 8 is formed in width of face of about 5mm, and the thickness of about 0.1mm. Such copper foil 8 is joined by five points at equal intervals on bus bar section 7a of the rear-face electrode 7. Thus, if copper foil 8 is joined to bus bar section 7a of the rear-face electrode 7 only by two or more places, even if the die length of copper foil 8 changes with temperature changes, copper foil 8 will not cut or curvature will not be produced in a substrate 1.

[0018] Bus bar section 5a of a surface electrode 5 and bus bar section 7a of the rear-face electrode 7 are connected with lead wire 9. This lead wire 9 is easy to be the same as that of the copper foil 6 stuck on a surface electrode 5. That is, it consists of width of face of 2mm, and about [ thickness 0.16mm ] copper foil. The bus bar section 5a side of the surface electrode 5 in this lead wire 9 is joined by two points, the abbreviation

center section in the die-length direction of bus bar section 5a, and an edge. For example, what is necessary is just to join two laps in all for lead wire 9 and copper foil 6 by die length of about 75mm, if it is the solar battery of 150mm angle. Thus, moreover, resistance loss can be reduced, without producing curvature etc. in a substrate 1, even if a substrate 1 is enlarged to 150mm angle extent if lead wire 9 is joined by two points, the abbreviation center section and edge by the side of bus bar section 5a of a surface electrode 5.

[0019] The rear-face electrode 7 side laps with copper foil 8 about 10-75mm, and joins lead wire 9 to it, for example. This rear-face electrode 7 side joins lead wire 9 by copper foil 8, one point, or two or more points.

[0020]

[Example] While forming the surface electrode 5 which changes from bus bar section 5a and finger section 5b to the front-face side of a substrate 1 The rear-face electrode 7 which changes from bus bar section 7a and the finger section also to a rear-face side is formed. The lead wire 9 which consists of copper foil with a width of face [ of 2mm ] and a thickness of 0.16mm is joined by five regular intervals points covering the overall length on bus bar section 5a of a surface electrode 5. The output characteristics of the solar battery element of structure and the curvature of a substrate 1 were measured covering the overall length on bus bar section 7a of a rear-face electrode conventionally which joined copper foil 8 with a width of face [ of 5mm ], and a thickness of 0.1mm by five regular intervals points, and connected lead wire 9 to the edge.

[0021] Moreover, while joining copper foil 6 with a width of face [ of 2mm ], and a thickness of 0.16mm by five regular intervals points on the surface electrode 5, the output characteristics of the solar battery element of structure and the curvature of a substrate 1 concerning invention of claim 1 which has arranged the lead wire 9 which consists of copper foil with a width of face [ of 2mm ] and a thickness of 0.16mm from the central part of bus bar section 5a to the edge side, and was joined by two places, the edge near the center section of the bus bar section, were measured. The result is shown in Table 1.

[0022] In addition, as shown in drawing 3, the thing of loop structure which connected two lead wire 9 by tie rod 9a was used for the edge of lead wire 9. Moreover, the cel property shown in Table 1 performs probe measurement, without attaching copper foil and lead wire to surface electrode 5 and rear-face electrode 7 part.

[0023]

[Table 1]

	<u>J<sub>sc</sub>(mA/cm<sup>2</sup>)</u>	<u>V<sub>oc</sub>(V)</u>	<u>F.F</u>	<u>Eff(%)</u>	<u>セル反り(mm)</u>
セル特性	30.88	0.594	0.749	13.51	-
従来構造	30.42	0.595	0.722	13.07	0.1
中央取出構造	30.44	0.595	0.728	13.19	0.1

[0024] If it is conventionally made the solar battery of the central fetch structure which starts like claim 1 in the solar battery of structure to the fall of F.F (curvilinear factor) being 3.6% (0.722/0.749) as shown in Table 1, the fall of F.F will be suppressed to 2.8% (0.728/0.749), and conversion efficiency will carry out improvement 0.12% (13.19-13.07). Moreover, the curvature of the cel of the central fetch structure of invention concerning claim 1 is 0.1mm, and was not conventionally different from the thing of structure.

[0025]

[Effect of the Invention] As mentioned above, according to invention concerning claim 1, copper foil is joined and prepared in the bus bar section of a surface electrode, by the increment in the cross section of an electrode section, since the lead wire which connects two or more solar battery elements to this copper foil from the abbreviation central part in that die-length direction was connected, since resistance loss decreases, F.F improves and output characteristics improve. Moreover, since the effect of telescopic motion by the thermal expansion when welding lead wire in order to wire lead wire from the abbreviation center section of the bus bar section serves as half in the direction of a bus bar of a substrate, the curvature of a cel becomes small.

[0026] Moreover, according to invention concerning claim 2, since copper foil is joined to the bus bar section of a surface electrode by two or more places, the curvature of a substrate can be more effectively made small.

[0027] Furthermore, according to invention concerning claim 3, since lead wire is joined to the copper foil by the side of a surface electrode by two or more places, the curvature of a substrate can be more effectively made small.

[Translation done.]

\* NOTICES \*

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.\*\*\*\* shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

---

DESCRIPTION OF DRAWINGS

---

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the solar battery element used for the solar-battery equipment of invention concerning claim 1, and (a) is a sectional view and (b) is a top view.

[Drawing 2] It is drawing showing 1 operation gestalt of the solar-battery equipment of invention concerning claim 1.

[Drawing 3] It is drawing showing the measuring method of the output characteristics of solar-battery equipment.

[Drawing 4] It is drawing showing conventional solar-battery equipment, and (a) is a sectional view and (b) is a top view.

[Description of Notations]

1 [ ... A rear-face electrode, 8 / ... The copper foil by the side of a rear-face electrode 9 / ... Lead wire ] ..... A substrate, 5 ... A surface electrode, 6 ... The copper foil by the side of a surface electrode, 7

---

[Translation done.]

(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開平11-214733

(43) 公開日 平成11年(1999) 8月6日

(51) Int. Cl.<sup>6</sup>

H 0 1 L 31/042

識別記号

P I

H 0 1 L 31/04

C

審査請求 未請求 請求項の数 3 O L (全 5 頁)

(21) 出願番号 特願平10-17039

(22) 出願日 平成10年(1998) 1月29日

(71) 出願人 000006633

京セラ株式会社

京都府京都市伏見区竹田島羽殿町6番地

(72) 発明者 高橋 宏明

滋賀県八日市市蛇瀬町長谷野1166番地の6

京セラ株式会社滋賀工場内

(72) 発明者 福井 健次

滋賀県八日市市蛇瀬町長谷野1166番地の6

京セラ株式会社滋賀工場内

(72) 発明者 白沢 勝彦

滋賀県八日市市蛇瀬町長谷野1166番地の6

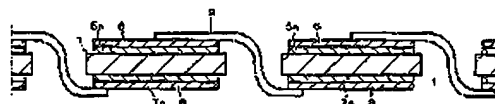
京セラ株式会社滋賀工場内

(54) 【発明の名称】 太陽電池装置

(57) 【要約】

【課題】 セル面積の増大に伴って抵抗損失が増大し、その対向策としてバスバー部の銅箔を厚くすると、セルの反り、セル割れ、或いは電極剥がれが発生するという問題があった。

【解決手段】 半導体接合部を有する半導体基板の一主面側にバスバー部とフィンガー部とから成る表面電極を形成し、他の主面側に裏面電極を形成した複数の太陽電池素子を設け、この複数の太陽電池素子の表面電極と裏面電極とをリード線で接続した太陽電池装置において、前記表面電極をバスバー部に銅箔を接合して設け、この銅箔の長さ方向における途中部分から前記リード線を接続する。





(2)

特開平11-214733

1

2

## 【特許請求の範囲】

【請求項1】 半導体接合部を有する半導体基板の一主面側にバスバー部とフィンガー部とから成る表面電極を形成し、他の主面側に裏面電極を形成した複数の太陽電池素子を設け、この複数の太陽電池素子の表面電極と裏面電極とをリード線で接続した太陽電池装置において、前記表面電極のバスバー部に銅箔を接合して設け、この銅箔にその長さ方向における途中部分から前記リード線を接続したことを特徴とする太陽電池装置。

【請求項2】 前記銅箔を前記表面電極のバスバー部に複数箇所て接合したことを特徴とする請求項1に記載の太陽電池装置。

【請求項3】 前記リード線を前記銅箔に複数箇所て接合することによって接続したことを特徴とする請求項1または請求項2に記載の太陽電池装置。

## 【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は太陽電池装置に関する。特に複数の太陽電池素子がリード線によって接続された太陽電池装置に関する。

【0002】

【従来の技術】従来の太陽電池装置を図4に示す。図4中、11はシリコン基板、15(15a)は表面電極、16(16a)は裏面電極、18はリード線である。シリコン基板11内にはN型領域12とP型領域13とがある。N型領域12の表面には表面電極15(15a)が設けられ、P型領域13の表面には裏面電極16(16a)が設けられている。この表面電極15はリード線接続用のバスバー部15aと集電用のフィンガー部15bとから成る。また、裏面電極16もバスバー部16aとフィンガー部(不図示)とから成る。裏面電極16のバスバー部16aには、抵抗損失を小さくするために銅箔がハンダ付されている。

【0003】複数の太陽電池素子を接続するためのリード線18は銅箔などから成り、一方端が表面電極15上の略全長にわたって配設され、その複数箇所を表面電極15と接合することによって表面電極15に接続され、他方端が銅箔17を介して裏面電極16のバスバー部16aの端部にハンダ付けされて裏面電極16に接続される。

【0004】

【発明が解決しようとする課題】この従来の太陽電池装置では、太陽電池素子のセル面積の増大に伴ない、発生電流が増加したり、また表面電極15のバスバー部15aが長くなり、そのために抵抗損失が増大して変換効率が低下するという問題があった。

【0005】変換効率の低下を防止するためには、表面電極15部分のリード線18や裏面電極16部分の銅箔17の断面積を増加させればよいが、表面電極15部分のリード線18は、受光面積を減少させないようにする

ために、その厚みを厚くして断面積を増加させなければならない。

【0006】ところが、リード線18が厚くなると、このリード線18をホットエアーやハンダ鍋で表面電極15に溶着する際に、このホットエアーやハンダ鍋の熱が表面電極15部分のハンダまで伝わりにくく、表面電極15とリード線18の溶着に時間がかかり、リード線18の熱膨張による伸びが大きくなるという問題があった。リード線18が伸びた状態で表面電極15に接合されると、リード線18が縮む際に、シリコン基板11に圧縮応力が印加されて、シリコン基板11に大きな反りが発生し、セル割れや電極剥がれなどを誘発し、製造歩留りが低下するという問題があった。

【0007】本発明はこのような従来の装置の問題点に鑑みてなされたもので、セル面積の増大にともなって発生する抵抗損失の増大と、その対向策であるバスバー部の銅箔を厚くすることによって発生するセルの反り、セル割れ、或いは電極剥がれなどの問題を解消した太陽電池装置を提供することを目的とする。

20 【0008】

【課題を解決するための手段】上記目的を達成するために、請求項1に係る発明では、半導体接合部を有する半導体基板の一主面側にバスバー部とフィンガー部とから成る表面電極を形成し、他の主面側に裏面電極を形成した複数の太陽電池素子を設け、この複数の太陽電池素子の表面電極と裏面電極とをリード線で接続した太陽電池装置において、前記表面電極をバスバー部に銅箔を接合して設け、この銅箔にその長さ方向における途中部分から前記リード線を接続する。

30 【0009】上記発明では、前記銅箔を前記表面電極のバスバー部に複数箇所て接合することが望ましい。

【0010】また、前記リード線を前記銅箔に複数箇所て接合することによって接続することが望ましい。

【0011】

【発明の実施の形態】以下、請求項1ないし請求項3に係る発明の実施形態を添付図面に基づき詳細に説明する。図1は請求項1ないし請求項3に係る発明の一実施形態を示す断面図と平面であり、1は半導体基板、5は表面電極、7は裏面電極、9はリード線である。

40 【0012】半導体基板1は、厚み0.3mm程度の単結晶シリコンや多結晶シリコンなどから成る。この半導体基板1内には、N型領域2とP型領域3とがあり、N型領域2とP型領域3との界面部分で半導体接合部4が形成される。このN型領域2はP型のシリコン基板1を拡散炉中に配置して、オキシン塩化リン(POCl<sub>3</sub>)、中で加熱することによって、シリコン基板1の全体の表面部にリン原子を拡散させ、その後に側面部と底面部の拡散層を除去することにより、厚み0.3～0.4μm程度に形成する。なお、この半導体基板1は単結晶ガリウム砒素などで形成してもよい。

(3)

特開平11-214733

3

4

【0013】N型領域2の表面部分には、表面電極5が形成されている。この表面電極5は、リード線9を接続するためのバスバー部5aとこのバスバー部5aと交差して分岐して形成されたフィンガー部5bとから成る。バスバー部5aは基板1の略全長にわたって二本平行に形成されており、フィンガー部5bはバスバー部5aに交差して多数本が基板1の略全長にわたって形成されている。バスバー部5aは例えば2mm程度の幅に形成され、フィンガー部5bは例えば0.2mm程度の幅に形成される。このような表面電極5は、例えば銀粉末、ガラスフリット、結合剤、および溶剤などから成るペーストをスクリーン印刷して700〜800℃程度の温度で焼き付け、全体をハンダ層で被覆することにより形成される。

【0014】この表面電極5(5a)上には銅箔6が貼りつけられている。この銅箔6は、表面電極5(5a)の断面積を大きくして表面電極5の電気抵抗を下げるために設けるものであり、幅2mm程度、厚み0.16mm程度に形成される。このような銅箔6を表面電極5上に例えば等間隔に5点で接合する。このように表面電極5と銅箔6とを複数箇所のみで接合すると、温度変化によって銅箔6の長さが変化しても、銅箔6が切断したり、基板1に反りを生じることがない。

【0015】基板1の表面側には、図示されていないが、例えば窒化シリコン膜などから成る反射防止膜が形成される。このような反射防止膜は例えばプラズマCVD法などで形成される。

【0016】基板1の裏面側には裏面電極7が設けられている。この裏面電極7も、リード線9を接続するためのバスバー部7aとこのバスバー部7aと交差して分岐して多数本形成されるフィンガー部(不図示)とから成る。バスバー部7aは基板1の略全長にわたって二本平行に形成されており、フィンガー部はバスバー部7aに交差して多数本が基板1の略全長にわたって形成されている。バスバー部7aは例えば5mm程度の幅に形成され、フィンガー部は例えば0.5mm程度の幅に形成される。基板1の裏面側は、受光面積の減少を考慮しなくてもよいことから、表面電極5のバスバー部5aよりも幅広に形成でき、裏面電極7側での抵抗損失を低減できる。このような裏面電極7は、例えば銀粉末、ガラスフリット、結合剤、および溶剤などから成るペーストをスクリーン印刷して焼き付け、ハンダ層で被覆することにより形成される。なお、裏面電極7は、バスバー部7aとフィンガー部7bを交差して設ける場合に限らず、基板1の裏面側の全面に設けてもよい。

【0017】この裏面電極7上には銅箔8が貼りつけられている。この銅箔8は、幅5mm程度、厚み0.1mm程度に形成される。このような銅箔8を裏面電極7の

バスバー部7a上に例えば等間隔に5点で接合する。このように裏面電極7のバスバー部7aと銅箔8を複数箇所のみで接合すると、温度変化によって銅箔8の長さが変化しても、銅箔8が切断したり、基板1に反りを生じることがない。

【0018】表面電極5のバスバー部5aと裏面電極7のバスバー部7aをリード線9で接続する。このリード線9は表面電極5上に貼りつけられる銅箔6と同一のものでよい。つまり、幅2mm、厚み0.16mm程度の銅箔で構成される。このリード線9における表面電極5のバスバー部5a側は、バスバー部5aの長さ方向における略中央部と端部の二点で接合される。例えば150mm角の太陽電池であれば、リード線9と銅箔6とを7.5mm程度の長さで重なり合わせて二点を接合すればよい。このように、リード線9を表面電極5のバスバー部5a側の略中央部と端部の二点で接合すると、基板1が150mm角程度に大型化しても基板1に反りなどを生じることなく、しかも抵抗損失を低減できる。

【0019】裏面電極7側はリード線9を銅箔8に例えば10〜75mm程度重なり合わせて接合する。この裏面電極7側はリード線9を銅箔8と一点もしくは複数点で接合する。

【0020】

【実施例】基板1の表面側にバスバー部5aとフィンガー部5bとから成る表面電極5を設けると共に、裏面側にもバスバー部7aとフィンガー部とから成る裏面電極7を設け、表面電極5のバスバー部5a上の全長にわたって、幅2mm、厚さ0.16mmの銅箔から成るリード線9を等間隔な5点で接合し、裏面電極のバスバー部7a上の全長にわたって、幅5mm、厚さ0.1mmの銅箔8を等間隔な5点で接合して端部にリード線9を接続した従来構造の太陽電池素子の出力特性と基板1の反りを測定した。

【0021】また、表面電極5上に幅2mm、厚さ0.16mmの銅箔6を等間隔な5点で接合するとともに、幅2mm、厚さ0.16mmの銅箔から成るリード線9をバスバー部5aの中央部分から端部側に配置してバスバー部の中央部近傍と端部の2箇所て接合した請求項1の発明に係る構造の太陽電池素子の出力特性と基板1の反りを測定した。その結果を表1に示す。

【0022】なお、リード線9の端部は、図3に示すように、二本のリード線9をタイバー9aで接続したループ構造のものをを用いた。また、表1に示すセル特性は表面電極5と裏面電極7部分に銅箔やリード線をつけずに鉗針測定を行ったものである。

【0023】

【表1】

(4)

特開平11-214733

5	$j_{sc}(mA/cm^2)$	$V_{oc}(V)$	F.F.	Eff(%)	セル反り(mm)
セル特性	30.38	0.594	0.749	13.51	-
従来構造	30.42	0.595	0.722	13.07	0.1
中央取出構造	30.44	0.595	0.728	13.19	0.1

【0024】表1に示すとおり、従来構造の太陽電池においては、F.F（曲線因子）の低下が3.6%（0.722/0.749）であるのに対して、請求項1のように係る中央取出構造の太陽電池にすると、F.Fの低下が2.8%（0.728/0.749）に抑えられ、変換効率が0.12%（13.19-13.07）向上する。また、請求項1に係る発明の中央取出構造のセルの反りは0.1mmであり、従来構造のものと変わらなかった。

【0025】

【発明の効果】以上のように、請求項1に係る発明によれば、表面電極のバスバー部に銅箔を接合して設け、この銅箔にその長さ方向における略中央部分から複数の太陽電池素子を接続するリード線を接続したことから、電極部分の断面積の増加によって、抵抗損失が減少することから、F.Fが向上し、出力特性が向上する。また、リード線をバスバー部の略中央部から配線するため、リード線を溶着するときの熱膨張による伸縮の影響が基板のバスバー方向において半分となるため、セルの反りが小さくなる。

10\* 【0026】また、請求項2に係る発明によれば、銅箔を表面電極のバスバー部に複数箇所て接合することから、基板の反りをより有効に小さくすることができる。

【0027】さらに、請求項3に係る発明によれば、リード線を表面電極側の銅箔に複数箇所て接合することから、基板の反りをより有効に小さくすることができる。

【図面の簡単な説明】

【図1】請求項1に係る発明の太陽電池装置に用いられる太陽電池素子を示す図であり、（a）は断面図、（b）は平面図である。

20 【図2】請求項1に係る発明の太陽電池装置の一実施形態を示す図である。

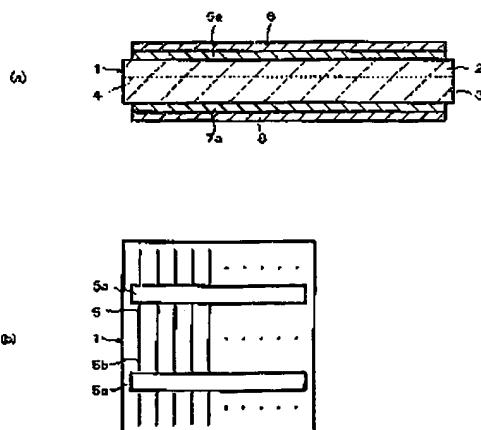
【図3】太陽電池装置の出力特性の測定方法を示す図である。

【図4】従来の太陽電池装置を示す図であり、（a）は断面図、（b）は平面図である。

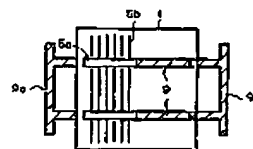
【符号の説明】

1……基板、5……表面電極、6……表面電極側の銅箔、7……裏面電極、8……裏面電極側の銅箔、9……リード線

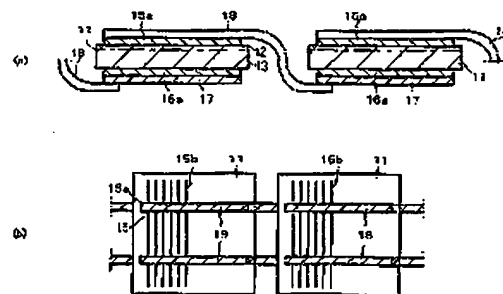
【図1】



【図3】



【図4】



(5)

特開平11-214733

【図2】

